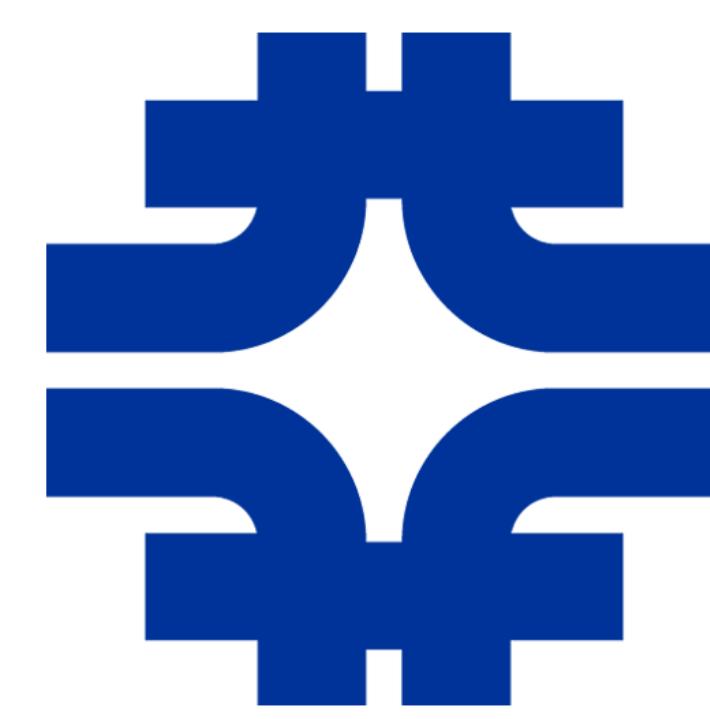




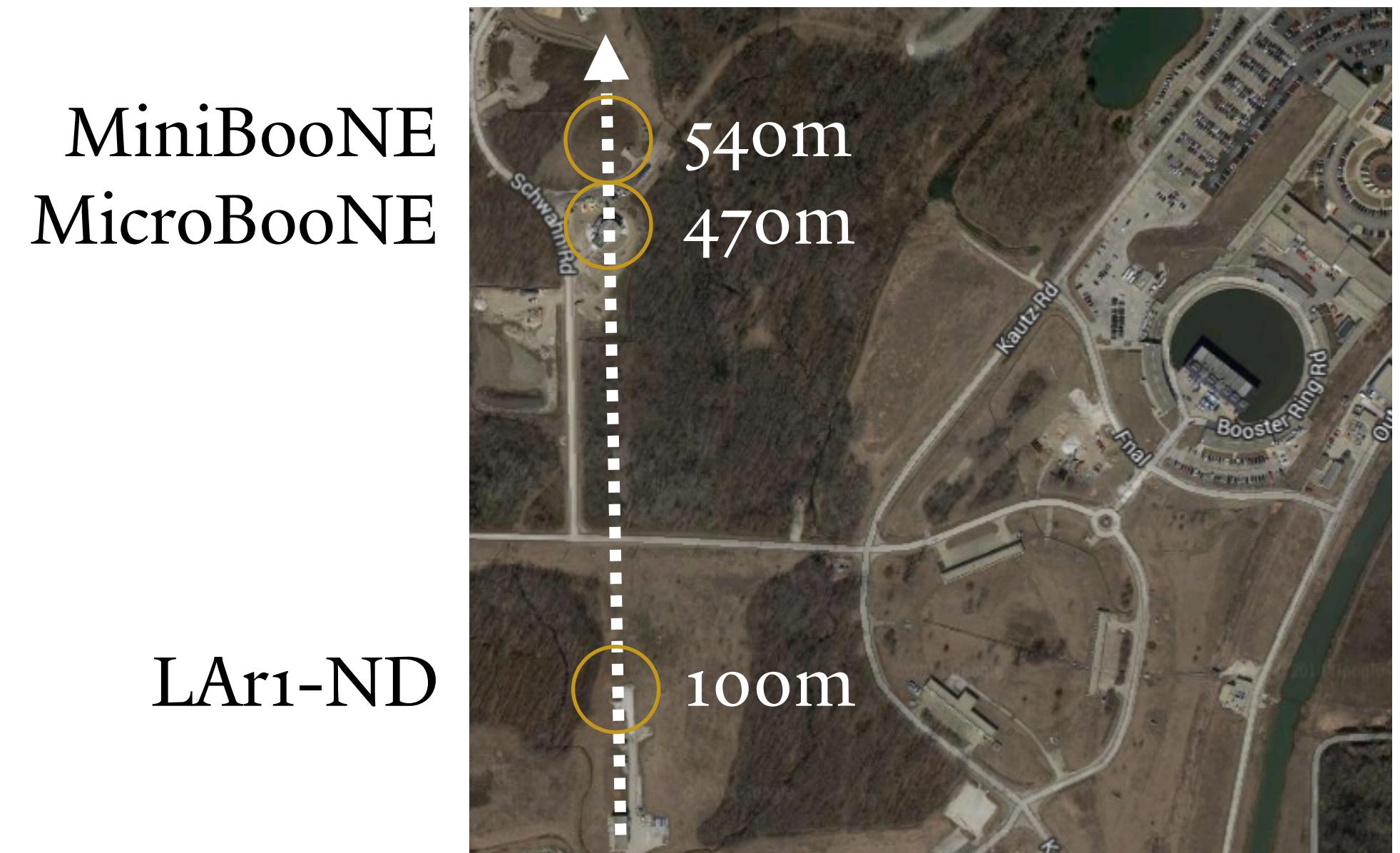
# Electron Neutrino Appearance with the Fermilab Short Baseline Program

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Presenting on behalf of MicroBooNE and LAr1-ND Collaborations

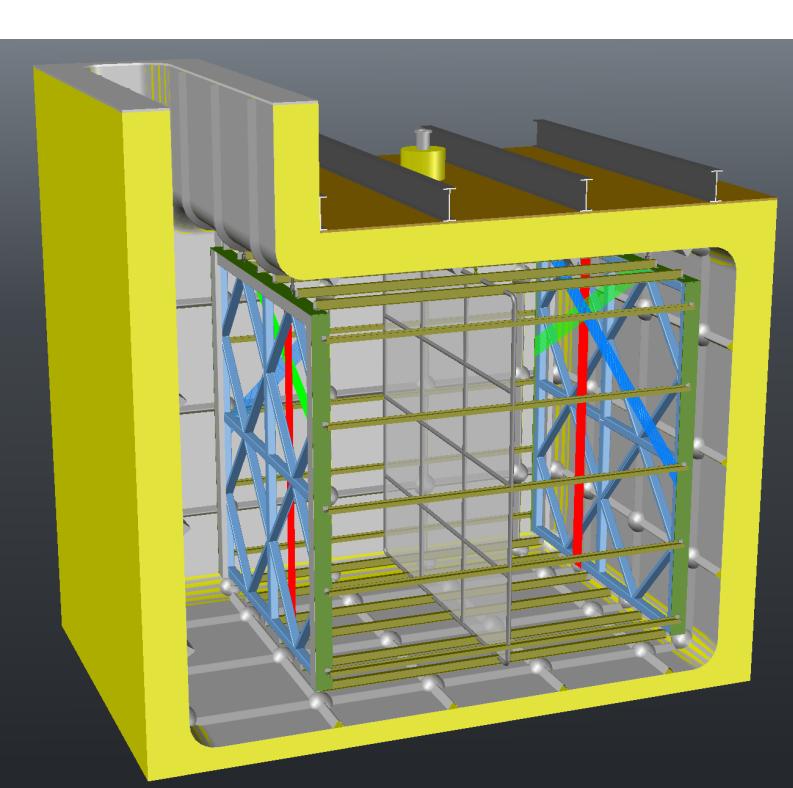
## Short Baseline Neutrinos



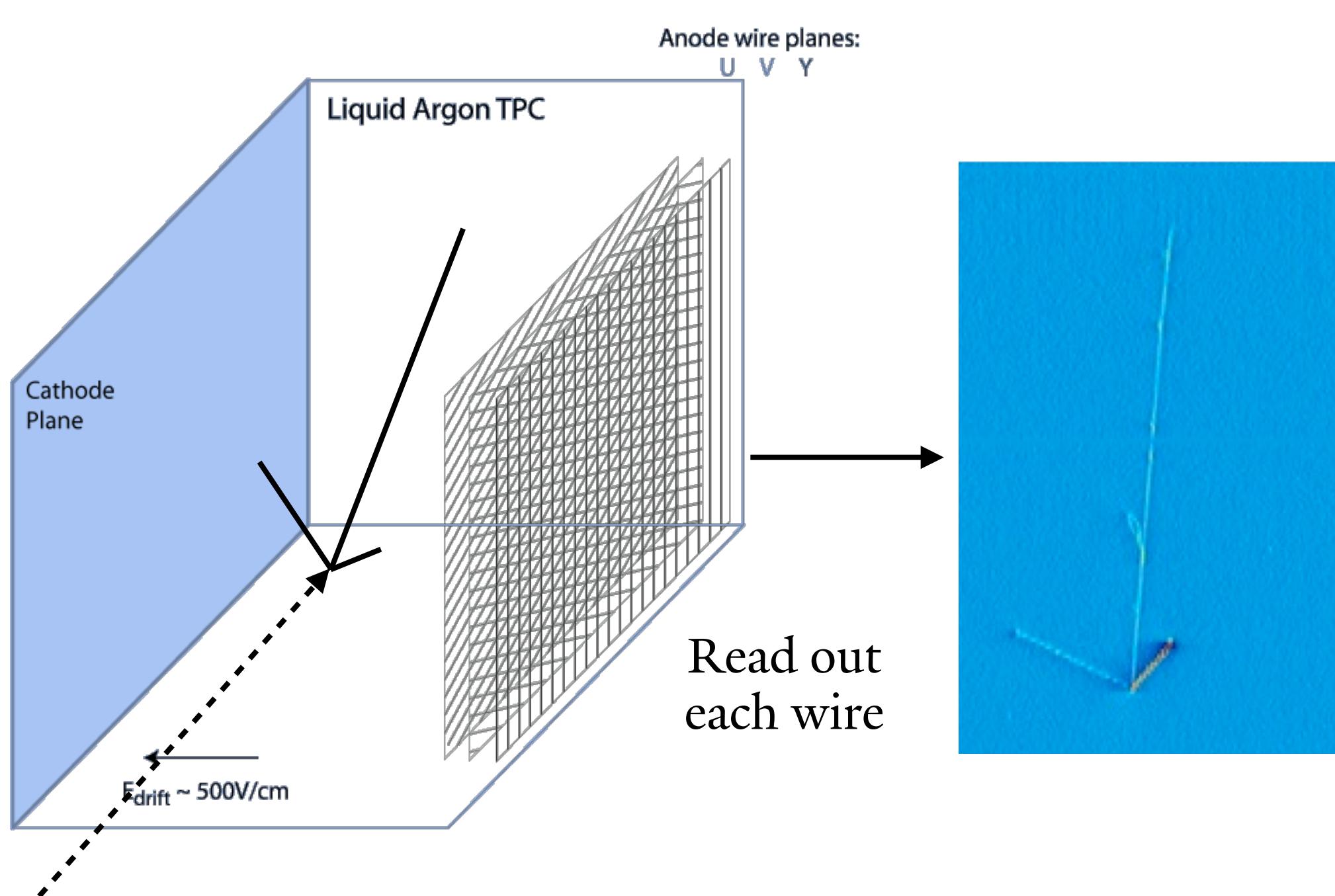
The Booster Neutrino Beam and multiple Liquid Argon Time Projection Chambers will be a world class Short Baseline Neutrino Experiment.

## Detectors

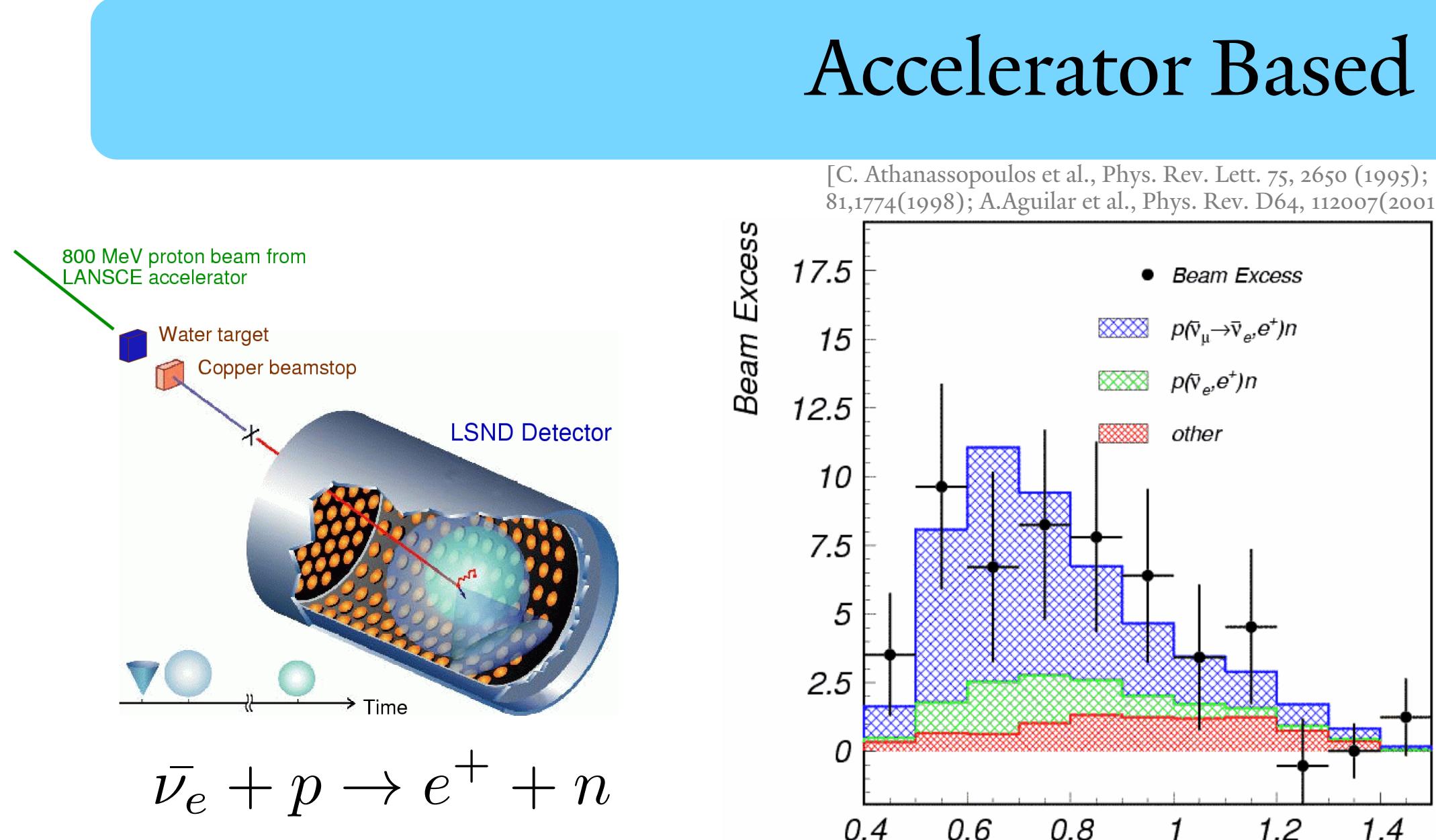
**MicroBooNE** is a 60 ton fiducial volume Liquid Argon Time Projection Chamber (LArTPC) being constructed at Fermilab.



LAr1-ND is a proposed near detector along the same beam line as MicroBooNE, currently under review by FermiLab.



## Short Baseline Oscillation Hints



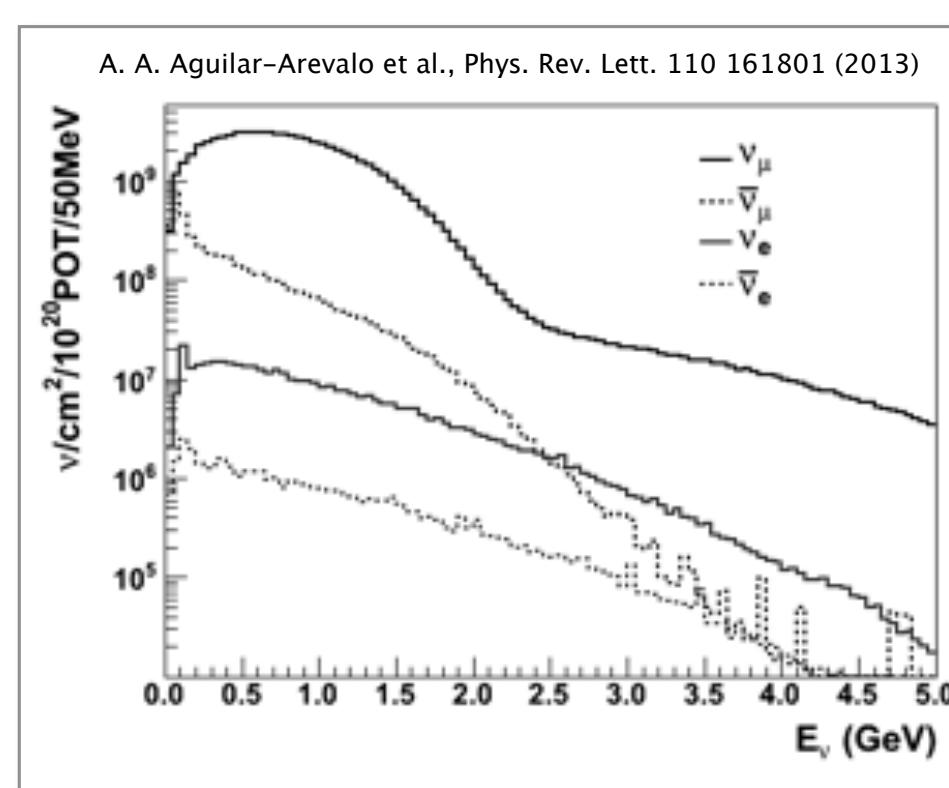
The Liquid Scintillator Neutrino Detector at Los Alamos National Lab observed an excess of  $\bar{\nu}_e$  in a  $\bar{\nu}_\mu$  beam.

## Confirming MiniBooNE

Process	Events ( $\mu B$ )	Events (LAr1-ND)	MiniBooNE unc.	dE/dx unc.	Total unc.	Error ( $\mu B$ )	Error (LAr1-ND)
$\mu \rightarrow \nu_e$	21.5	171.3	0.26	0.1	0.28	6.0	47.7
$K^+ \rightarrow \nu_e$	6.4	51.3	0.22	0.1	0.24	1.55	12.4
$K^0 \rightarrow \nu_e$	1.8	14.7	0.38	0.1	0.39	0.73	5.79
$\nu_\mu e \rightarrow \nu_\mu e$	4.9	38.9	0.26	0.0	0.26	1.27	10.1
$\nu_\mu e \rightarrow \nu_\mu e$	3.8	30.7	0.25	0.1	0.27	1.03	8.26
$NC \pi^0$	6.7	53.4	0.13	0.1	0.16	1.10	8.77
Dirt	0.9	6.9	0.16	0.1	0.19	0.16	1.31
$\Delta \rightarrow N\gamma$	2.5	19.8	0.14	0.1	0.17	0.43	3.40
Other	0.9	7.6	0.25	0.1	0.27	0.26	2.04
Total	49.4	322.1			6.55	52.23	
MicroBooNE							
Total Events	97	775					
"Low-energy Excess"	47.6	380					
Background	49.4	394.6					
Statistical Error	7.0	19.9					
Systematic Error	6.6	52.2					
Total Error	9.6	55.9					
Statistical Significance of Excess	6.8 $\sigma$	19.1 $\sigma$					
Total Significance of Excess	5.0 $\sigma$	6.8 $\sigma$					

MicroBooNE will be able to confirm or reject the MiniBooNE result after 3 years of running and determine if the excess is due to electrons or photons.

- Electron Neutrino Cross section is unmeasured on argon at these energies.
- Flux Uncertainties are a concern in determining backgrounds to an electron neutrino appearance search.



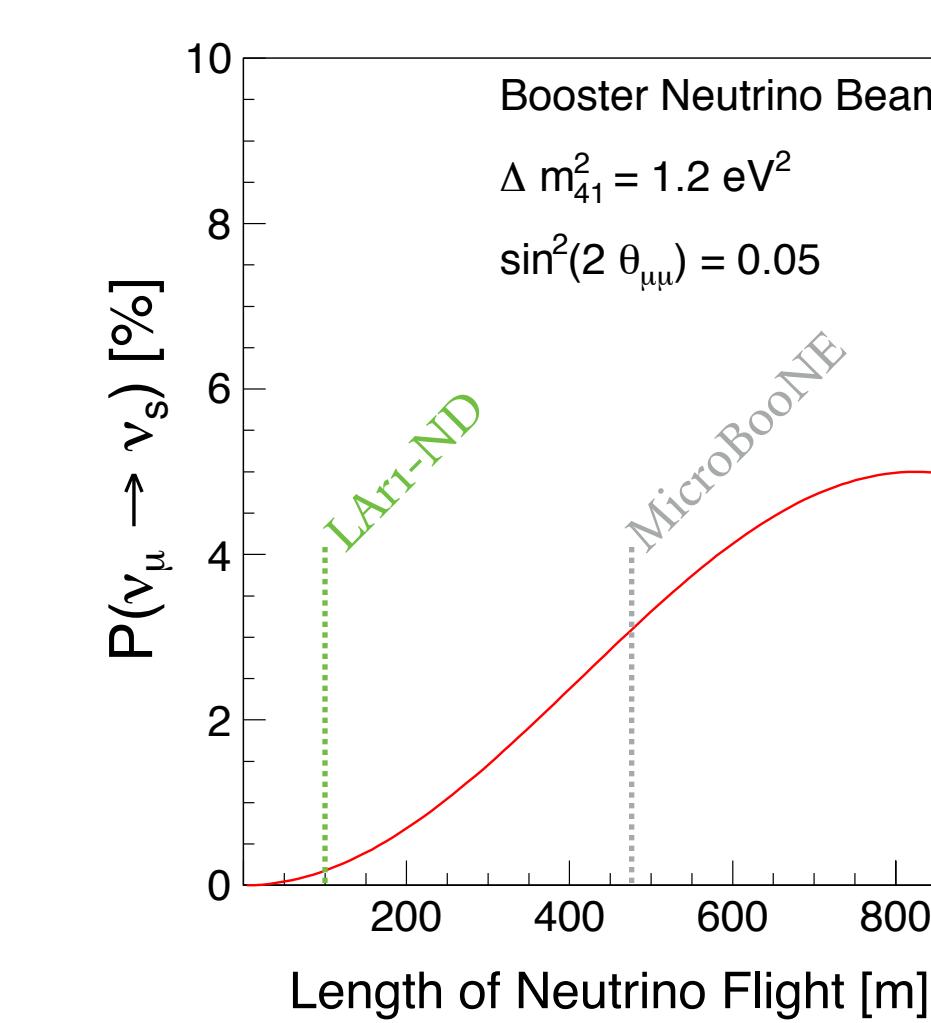
Biggest uncertainties in MicroBooNE are neutrino flux and cross section - best addressed with a near detector.

- MiniBooNE at Fermilab also saw an excess of events, but could not definitively classify them as electrons or photons.
- MicroBooNE is designed to resolve the MiniBooNE anomaly.

## Characterizing An Excess?

If an excess is observed, the next question to ask is: does this excess appear over a distance or is it intrinsic to the beam?

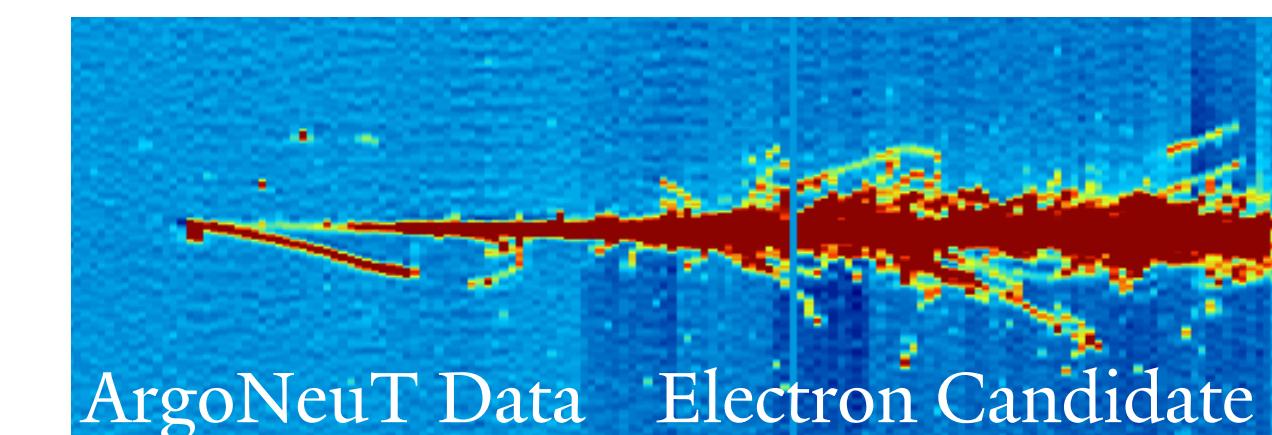
This can only be answered with a near detector.



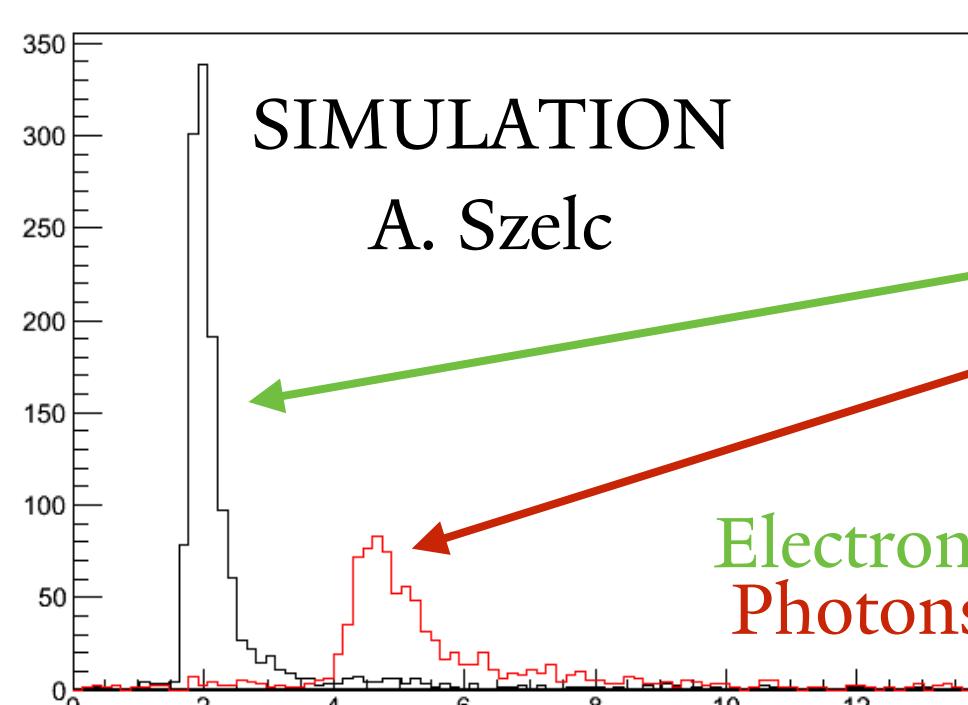
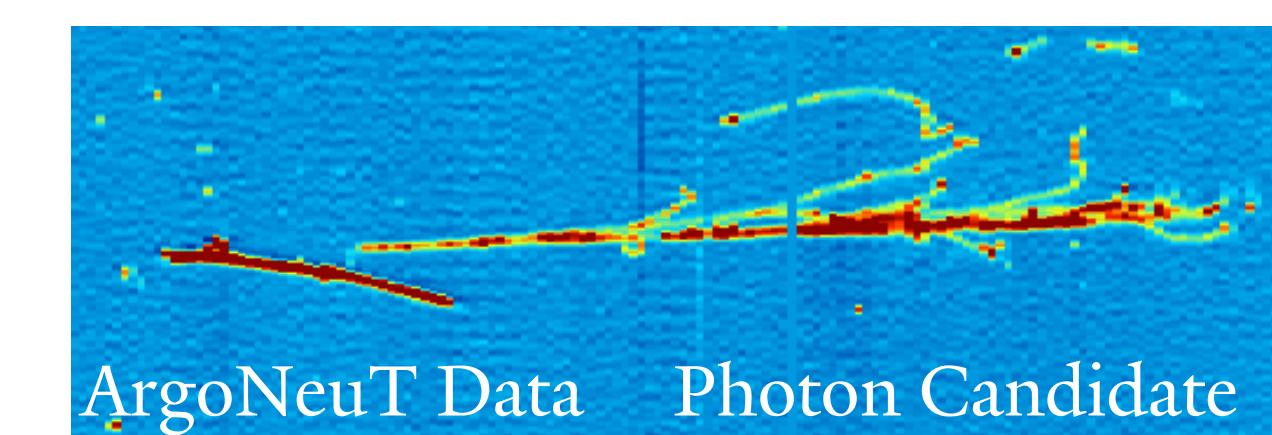
A near detector such as LAr1-ND must be placed at the source of the beam to make a measurement before the onset of oscillations.

## Electron Photon Separation

### MiniBooNE Signature

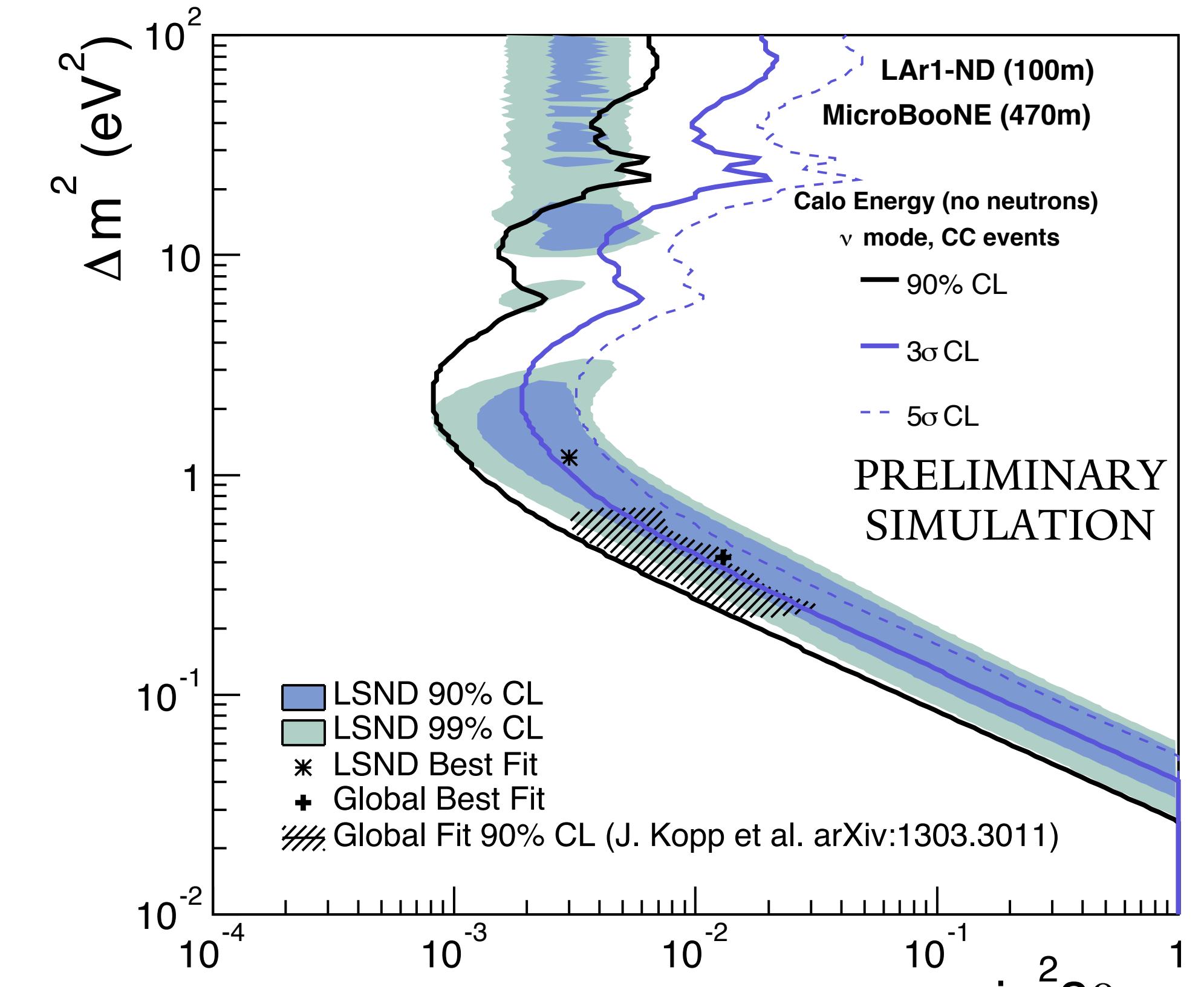


### Electron, Photon



See talk from A. Szeli!

## Experimental Sensitivity



MicroBooNE, combined with a near detector such as LAr1-ND, can begin to probe much of the LSND allowed region at 90% confidence limit.